EFFECT OF SOWING TIME AND VARIETY ON SEED GERMINATION AND VIGOUR INDEX OF WHEAT

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Abstract

Experiments were carried out in research field and laboratory of Seed Technology Division, Bangladesh Agricultural Research Institute, Gazipur during *rabi* season of 2008-09 and 2009-10 to find out the effect of sowing time and variety on seed germination and vigour index of wheat after harvest of the crop. There were two sets of treatments, comprising a) three dates of sowing viz. 20 November, 5 December and 20 December; and b) three varieties viz. 'Bijoy', 'Sufi' and 'Prodip'. Split plot design and complete block design were followed in field and laboratory experiments, respectively. Results revealed that the highest seed germination 93.33% was recorded in 'Prodip' sown on 20 December, 2008 and 'Bijoy' sown on 5 December, 2009. However, all the varieties showed more than 83% seed germination at all dates of sowing of wheat. The highest vigour indices, 1.53 and 1.41 were found in the seeds of 'Sufi' sown on 20 November in both the years of 2008 and 2009, respectively.

Keywords: wheat, sowing time, variety, seed germination, vigour index.

Introduction

Wheat is the second most important food grains in Bangladesh. Rice and wheat altogether occupied over 80% of the total cropped area. In 2010-11, the total area and productions of wheat in the country were 3.74 lac hectares and 9.72 lac. MT (BBS, 2011). Quality seed is considered as the basic critical input which directly affects yield and could increase crop production by 10-15% (Mondal, 2005), while BADC (2012) reported that quality seed alone can contribute to the increase of yield by 15-20%. In order to maintain purity and quality of seeds several steps should be undertaken. Sowing in optimum time, application of balanced fertilizer and irrigation in proper time, rouging and weeding are essential for successful seed production. Greven *et al.* (2004) reported that timing of harvest is an important factor since both seed immaturity and weathering reduce seed quality. Kumar *et al.* (2002) reported that seed yield and quality largely depend on the stage of maturity of crops. Shaheb *et al.* (2011 and 2012) reported higher seed yield of wheat from November sowing and seed yield was decreased with the delaying of sowing time. Dharmalingam and Basu (1990) reported that seed development and maturation are important because the seeds are harvested to ensure good yield associated with viability, vigour and field performance. Harvesting with high moisture content increases the chances of

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mycofloral infection on seed, while harvesting at low moisture content increases mechanical damage to seed (Yadav *et al*., 2005). The seed reaches its maximum dry weight at physiological maturity and should be harvested at proper time to ensure better germinability and vigour. Late sowing, higher plant population, desiccation and earlier harvesting reduces seed size of dwarf French beans, and seed germination of all treatments is ≥ 91% though significant differences are found in seed vigour (Greven *et. at.*, 2004).

The seed quality in general does not change significantly between physiological maturity (PM) and harvest maturity (HM), but in some cases the proportion of viable seeds increases between PM and HM, especially when ambient temperatures are relatively low (Muasya *et al*., 2008). Thus harvesting of seed crop at optimum stage of seed maturation is essential to obtain better seed quality. The major three aspects of seed quality are a) genetic and physical maturity, b) high germination percentage and vigour, and c) freedom from seed-borne disease and insects (Seshu and Dadlani, 1989). There is hardly any literature available on seed quality studies on popular varieties of wheat sown at different times in Bangladesh. Hence, the experiment was undertaken to see the effect of sowing time and variety on the seed germination and vigour index after the harvest of wheat.

Materials and Method

Experiments were conducted in research field and laboratory of Seed Technology Division, Bangladesh Agricultural Research Institute, Gazipur during *rabi* season of November 2008 to April 2010. There were two sets of treatments comprising a) three dates of sowing viz. S_1: 20 November, S_2: 5 December and S_3: 20 December; and b) three varieties viz. V_1: 'Bijoy', V_2: 'Sufi' and V_3: 'Prodip'. The field experiment was laid out in a split plot design with three replications assigning sowing time in main plot and variety in sub plot for field and completely randomized design was followed for laboratory studies. The unit plot size was 3m x 5m. The land was fertilized with 92, 32, 23 and 20 kg ha^{-1} of N, P, K and S, respectively. One-third of N and all other fertilizers were applied at final land preparation. Seeds were sown in furrows at the rate of 120 kg ha^{-1} in 20 cm apart rows. The two years weather data are given in Fig.1 and 2.
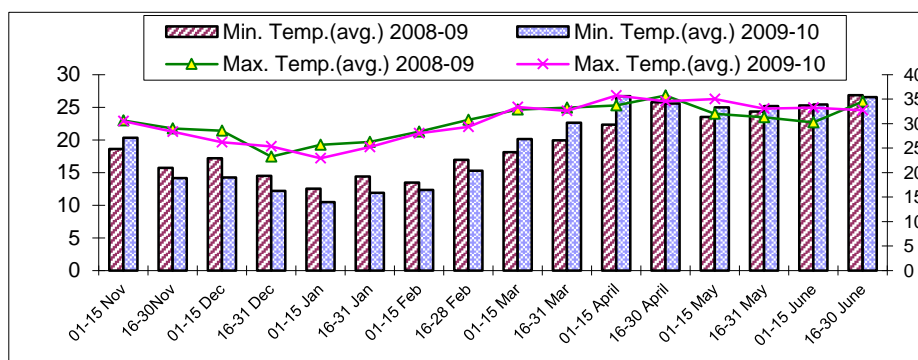

Fig. 1. **Mean maximum and minimum temperature (^{0}C) data at Joydebpur, Gazipur from November to June (2008-10).**
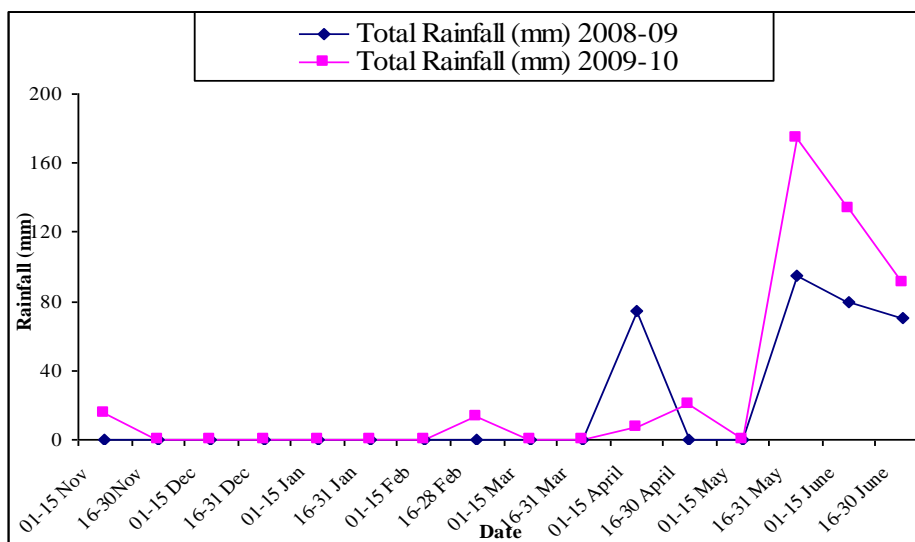
Fig. 2. Total rainfall (mm) data at Joydebpur, Gazipur from November to June (2008-10).

From the figures, it was observed that the average maximum temperatures (around 34^0C) were in the month April in both the years while the lowest minimum temperature was recorded in the middle of January (above 9^oC). There was almost no rainfall recorded during the growing period (November to February) of wheat in both the years except in the last week of February, when only 5 mm of precipitation was recorded. However, total rainfall ranged from 5 mm to well above 160 mm.

All intercultural operations viz. weeding, thinning, irrigation and drainage were carried out as and when necessary. The wheat varieties sown on 20 November, 05 December and 20 December were harvested on 11 March, 23 March and 05 April, respectively. After threshing, seeds of each plot were sun dried and then cleaned properly. Seed quality parameters including seed vigour data of wheat varieties were recorded as per following methods:

Determination of moisture content

The moisture content (MC) of seed sample as per treatment was determined after harvest according to ISTA (1999). Ground seed samples of each treatment were taken into moisture cup and put into a pre heated oven at temperature of 103 ± 2^0C for one hour according to Morshed *et al.* (2003). After cooling, the weight of the container with its cover and contents were taken. The seed samples were cooled in desiccators and weighed to work out the percent moisture content of the grains. However, the MC of all varieties harvested at different dates were brought and

adjusted at 11.50%. The seed moisture content was determined by dry weight basis and was calculated by the following formula:

$$\text{Seed moisture content (\%)} = \frac{M_2 - M_3}{M_2 - M_1} \times 100 \dots \dots \dots \dots \dots \dots \dots \dots (i)$$

Where,

M_1 is the weight in grams of the container and its cover,

M_2 is the weight in grams of the container, its cover and its contents before drying

M_3 is the weight in grams of the container, its cover and contents after drying.

Determination of germination percentage

The data on seed germination (%) was taken out after harvest by the following formula (ISTA, 1999). For each treatment, 100 seeds were put into large petri dishes with four replications. The Petri-dishes were then put at room temperature (25 ± 2^0C). After eight days, sprouted normal, abnormal and diseased seeds were counted by the following formula:

$$\text{Seed Germination (\%)} = \frac{\text{No. of seed germinated}}{\text{Total seed}} \times 100 \dots \dots \dots \dots \dots (ii)$$

Measurement of root and shoot length

From the eight days of seedlings, 10 plants were randomly selected. Seedlings were then cut and root and shoot parts were separated and their lengths were measured.

Determination of fresh and dry weight of seedling

After measurement of root and shoot length, fresh weight and dry weight of seedlings were recorded. Then the root and seedlings were put into paper packet and placed into the preheated oven (70^0C$\pm$ 2^0C) for 48 hours. After cooling in desiccators, the dry weights were taken.

Determination of vigour index

Seed vigour index was calculated and determined by multiplying germination (%) and seedling dry weight according to Abdul-Baki and Anderson (1973) and Reddy and Khan (2001).

$$\text{Vigour index (VI)} = \text{PG} \times \text{SDW} \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots (iii)$$

Where,
VI = Vigour index;
PG =Percent germination of seed, and
SDW = Seedling dry weight (Average)

The collected data were analyzed statistically following the ANOVA technique with the help of MSTAT-C software. The mean differences among the treatment means were done by Least Significant Difference (LSD) test (Gomez and Gomez, 1984).

Results and Discussion

Results obtained from the two consecutive years of 2008-09 and 2009-10 were presented in Tables 1-3.

Effect of sowing time on the seed quality of wheat

Significant variations were observed due to different sowing time on the seed quality of wheat viz. shoot length and vigour index for both 2008-09 and 2009-10 and only in root length of seedling in 2008-09, though the others were not significant (Table 1). It revealed that the highest shoot lengths (11.88 and 12.95 cm) were found from 20 December sowing during the year 2008-09 and 2009-10, respectively while the lowest shoot lengths (11.11 and 11.70 cm) were recorded from 20 November sowing. The highest seed vigour indices, 1.38 and 1.30, were recorded in 20 November and 05 December sowing from the year 2008-09 and 2009-2010, respectively and the lowest seed vigour indices, 1.15 and 1.02, were observed from 20 December sowing in 2008-09 and 2009-10, respectively.

Effect of variety on the seed quality of wheat

Wheat varieties showed significant differences on the seed quality of wheat viz. seedling root and shoot length in 2008-09 and 2009-10 and seed germination and vigour index only for the year 2008-09 and the other characters were not significant (Table 2). In 2008-09, the highest seed germination (92.44%) was found from the variety 'Sufi' and the lowest (87.78%) was found in the variety 'Bijoy'. The highest seedling root lengths (11.99 and 12.13 cm) were observed in variety 'Prodip' and 'Sufi' in 2008-09 and 2009-2010, respectively while the lowest seedling root lengths (10.71 and 10.48 cm) were found in the variety 'Bijoy' both from the years, respectively. The highest shoot lengths (11.79 and 13.16cm) were observed in the variety 'Prodip' and 'Bijoy', respectively and the lowest shoot lengths (10.94 and 11.64 cm) were found in variety 'Bijoy' and 'Sufi' in the year 2008-09 and 2009-2010, respectively. However, in 2008-09, the highest vigour index (1.44) was found in the variety 'Sufi' and the lowest vigour index (1.19) was obtained in variety Prodip, respectively (Table 2).

Combined effect of sowing time and variety on the seed quality of wheat

It was observed that seed germination, root and shoot lengths, root-shoot ratio and vigour index of wheat were significantly affected by sowing time and variety though the other parameters were not significant (Table 3). The highest seed germination (93.33%) and shoot length (12.23 cm) were recorded in the treatment

Table 1. Effect of sowing time on seed germination, seedling root and shoot length, seedling dry weight and vigour index of wheat.

Sowing time	Seed germination (%)		Root length (cm)		Shoot length (cm)		Root-shoot ratio		Seedling dry weight (g)		Vigour index	
	2008-09	2009-10	2008-09	2009-10	2008-09	2009-10	2008-09	2009-10	2008-09	2009-10	2008-09	2009-10
S_1	90.00	89.78	11.26	11.04	11.11	11.70	1.01	0.95	0.013	0.012	1.17	1.08
S_2	89.56	91.11	11.59	11.61	11.33	12.34	1.03	0.94	0.015	0.014	1.34	1.28
S_3	95.44	91.11	11.79	11.76	11.88	12.95	0.99	0.93	0.015	0.012	1.43	1.09
LSD(0.05)	NS	NS	0.159	NS	0.399	0.841	NS	NS	NS	NS	0.19	0.14
CV (%)	3.26	5.72	3.77	7.24	2.66	5.91	4.12	8.30	9.25	12.56	10.02	11.28

NS= Not significant.

S_1: 20 November, S_2: 07 December and S_3: 20 December.

Table 2. Effect of variety on seed germination, seedling root and shoot length, seedling dry weight and vigour index of wheat.

Variety	Seed germination (%)		Root length (cm)		Shoot length (cm)		Root-shoot ratio		Seedling dry weight (g)		Vigour index	
	2008-09	2009-10	2008-09	2009-10	2008-09	2009-10	2008-09	2009-10	2008-09	2009-10	2008-09	2009-10
V_1	87.78	89.78	10.71	10.48	10.94	13.16	0.98	0.80	0.014	0.013	1.23	1.17
V_2	92.44	91.56	11.94	12.13	11.59	11.64	1.03	1.04	0.016	0.012	1.48	1.10
V_3	91.78	90.67	11.99	11.80	11.79	12.19	1.02	0.97	0.013	0.013	1.19	1.18
LSD(0.05)	3.04	NS	0.14	0.85	0.31	0.75	0.05	0.08	NS	NS	0.15	NS
CV (%)	3.26	5.72	3.77	7.24	2.66	5.91	4.12	8.30	9.25	12.56	10.02	11.28

NS= Not significant.

V_1: 'Bijoy', V_2: 'Sufi' and V_3: 'Prodip'.

Table 3. Combined effect of sowing time and variety on seed germination, seedling root and shoot length, seedling dry weight and vigour index of wheat

Sowing time × variety	Seed germination (%)		Root length (cm)		Shoot length (cm)		Root-shoot ratio		Ave. seedling dry weight (g)		Vigour index	
	2008-09	2009-10	2008-09	2009-10	2008-09	2009-10	2008-09	2009-10	2008-09	2009-10	2008-09	2009-10
$S_1 \times V_1$	84.00	85.33	11.24	10.85	11.11	12.15	1.01	0.89	0.014	0.012	1.18	1.02
$S_1 \times V_2$	92.67	92.00	11.28	11.15	11.13	10.90	1.01	01.03	0.015	0.012	1.39	1.10
$S_1 \times V_3$	93.33	92.00	11.27	11.12	11.08	12.05	1.01	0.92	0.010	0.011	0.93	1.01
$S_2 \times V_1$	88.00	93.33	10.45	10.50	10.40	12.98	1.01	0.81	0.015	0.015	1.32	1.40
$S_2 \times V_2$	91.33	91.33	12.20	12.22	11.42	12.53	1.07	0.81	0.016	0.013	1.46	1.19
$S_2 \times V_3$	89.33	88.67	12.13	12.12	12.18	11.51	1.00	0.97	0.014	0.015	1.25	1.33
$S_3 \times V_1$	91.33	90.67	10.43	10.09	11.31	14.53	0.92	1.05	0.014	0.010	1.28	0.91
$S_3 \times V_2$	93.33	91.33	12.35	13.01	12.23	11.49	1.01	0.70	0.016	0.012	1.49	1.10
$S_3 \times V_3$	92.67	91.33	12.58	12.17	12.10	13.02	1.04	1.13	0.015	0.013	1.39	1.19
LSD(0.05)	5.26	NS	0.25	1.48	0.54	1.29	0.08	NS	NS	NS	0.47	NS
CV (%)	3.26	5.72	3.77	7.24	2.66	5.91	4.12	0.137	9.25	12.56	10.02	11.28

NS= Not significant.

S_1: 20 November, S_2: 07 December and S_3: 20 December and V_1: 'Bijoy', V_2: 'Sufi' and V_3: 'Prodip'.

combination $S_3 \times V_2$ and the lowest was found from the treatment combination $S_1 \times V_1$ and $S_1 \times V_3$, respectively in 2008-09 while in 2009-10, these values were recorded higher (93.33% and 14.53 cm) in the treatment combination of $S_2 \times V_1$ and $S_3 \times V_1$, respectively. The lowest values of seed germination (85.33%) and shoot length (10.90 cm) were obtained in the treatment combination $S_1 \times V_2$. The highest seedling root lengths (12.58 and 13.01 cm) were observed in $S_3 \times V_3$ and $S_3 \times V_2$ in the year 2008-09 and 2009-10, respectively and the lowest values (10.43 and 10.09 cm) were recorded in $S_3 \times V_1$ treatment combination, respectively in both the years. In case of vigour index, the variety 'Sufi' sown on 20 November showed the highest vigour indices (1.53 and 1.41) in the year 2008-09 and 2009-10, respectively. The lowest values of vigour indices (0.96 and 0.95) were recorded from the treatment combinations $S_1 \times V_3$ (the variety 'Prodip' sown on 20 November) and $S_3 \times V_1$ (the variety 'Prodip' sown on 20 December) during the year 2008-09 and 2009-10, respectively. The seed lot showing higher seed vigour index is considered to be more vigorous (Abdul-Baki and Anderson, 1973). The results are in agreement with the findings of Ayyub *et al.* (2007) who reported that physiologically mature seeds displayed better viability and seed quality. The results are also in line with the findings of Seshu and Dadlani (1989) who asserted that high germination percentage and vigour are significant aspects of seed quality. Quality seed with higher germination percentage and vigour index might be contributed to get optimum plant population, growth and development. This was also supported by Parera and Cantliffe (1994) who reported that rapid and uniform field emergence is essential to achieve better growth and high yield. Findings of previous works also showed that variation in seed germination and vigour were observed due to variation in sowing date (Tekrony *et al.*, 1997 and Rahman *et al.*, 2005). Adam *et al.* (1989) reported that early sowing of seed was associated with more yield and higher seed quality than late sowing in Ohio, USA. Similar findings were also reported in soybean by Rahman *et al.* (2013) who observed that germination percentage and vigour index of seed decreased with delayed sowing.

Conclusion

The present investigation revealed that most of the seed quality parameters were significantly influenced by date of sowing and variety. The highest seed germination 93.33% was recorded in the seeds of 'Prodip' variety sown on 20 December 2008, and 'Bijoy' variety sown on 5 December 2009, respectively. However, all the varieties showed more than 83% seed germination at all the dates of sowing. The highest vigour indices (1.53 and 1.41) were found in the seeds of 'Sufi' variety sown on 20 November in both the years of 2008-09 and 2009-10, respectively. Although seed germination and vigour index of wheat varieties were influenced by sowing times, all the tested varieties exhibited better seed quality immediately after harvest.

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